

UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 20.

Examinations of Stream and Well Waters.

Water from the Artesian well at the Stockton Asylum for the Insane. A sample of this water was sent on behalf of the directors of the institution by Mr. M. W. Fitzhugh, of the State Engineers' Department, for the purpose of analysis. The following statements were made at the same time concerning the well itself:

"The Asylum Directors have, at considerable expense, bored an artesian well for the purpose of striking a stratum of water highly charged with combustible gas. There is another well some five miles southeast of town, which has been throwing out large quantities of such gas. The gas was struck at the Asylum well last week at the depth of 1,100 feet; it is highly combustible, and burns with an almost colorless flame, slightly blue, similar to hydrogen. There is enough gas to run the engines, and about 15 miners' inches of water were flowing from the well. In the latter there are two pipes, one eight inches in diameter, going down 1,000 feet; the other, inside the larger, five inches diameter, which goes down 1,100 feet. It is through the latter that the gas-bearing water now flows, some five miners' inches."

The gas is in the main marsh gas or "light carburetted hydrogen," with some carbonic acid and probably some hydrogen gas. Its analysis has not yet been completed. The water is clear and has a flatfish, somewhat saline taste, and curdles soap with great energy. On evaporation it yields a solid residue at the rate of 237.1 grains per gallon; of this amount 28 grains is water, with some organic matter, which is dissipated by ignition, leaving 209 grains of strictly mineral matter, of which 201.17 grains was again soluble in water. The composition of these several portions was:

SOLUBLE PART.		Grains per Gal.	Per Ct.
Chloride of Sodium (Common Salt)	124.15	59.33	
Chloride of Magnesium (Bittern)	17.36	8.30	
Chloride of Calcium	59.09	28.27	
Sulphate of Lime (Gypsum)57	.27	
Total Soluble	201.17	96.22	
INSOLUBLE PART.			
Carbonate of Lime	4.09	1.96	
Silica	3.81	1.82	
Total Insoluble	7.90	3.78	

The analysis shows the main ingredient of this water to be common salt, associated with about half as much of the chloride of calcium, and smaller amounts of bittern and gypsum—all substances belonging more or less to salt brines and sea water. The carbonic acid gas carried by the water, moreover, carries into it some carbonate of lime and silica, which are precipitated on boiling, and will form a deposit on the walls of boilers, etc. The amount of mineral matter in this water—over 200 grains per gallon—is far too great to allow of its use for domestic or irrigating purposes, nor is there any method, short of distillation, by which the saline contents could be materially reduced.

It has been stated in a previous bulletin (No. 14) that a similar water has been found in a deep well about ten miles northward of Visalia, differing entirely in character from the other waters of the "Tulare artesian belt." From information since received through the State Engineers' Office, it appears probable that a belt of similar saline waters extends on a certain line northward through Merced and Stanislaus counties to San Joaquin; while elsewhere in the same counties the bored wells yield waters similar to those of southern Tulare, that are either naturally pure enough for practical uses, or can readily be made so by proper treatment. It would be of extreme interest to these counties that this belt should be defined, so that useless expenditure may not be incurred where it is certain that saline water only can be obtained. The use of water like that of the Stockton well for irrigation can only result in rendering the land unproductive, while in domestic use it would shortly cause the consumer to succumb to malarial influences by weakening the digestive organs.

Waters from near Mission San Jose. It is well known that a great variety of mineral waters are found in various portions of the Coast Range off the Santa Clara valley, this feature culminating probably in the "Alum Rock canyon," five miles from the city of San Jose, where at least four entirely distinct kinds of mineral water are found. However salutary may be the use of such waters in appropriate cases of disease, it need hardly be said that they should not, any more than any other class of medicines, form part of our daily diet, as such irrational use is sure to induce disorders. To such causes may frequently be traced the local reputation of certain localities for healthfulness or the reverse, when there exist no possible climatic or other local causes for such diversity. Mission San Jose has been noted for its health-

fulness, and by many this fact has been ascribed to the quality of the water. The supply has thus far been derived either from Mission creek or from a spring at the mouth of the canyon. But of late, the increase of settlements has caused the use of wells, as well as of springs not heretofore utilized; and in some cases complaints have arisen which were directly traced to the drinking water used. The following analysis of one of these, and a comparative examination of some others, throws some light on the subject, and shows how easily in many cases such troubles may be remedied, when a chemical examination has revealed the cause.

The water analyzed is from a spring creek on the land of Antonio Salazar, half a mile southwest from the Mission. The use of this water for drinking had, in the course of a week, produced unpleasant purgative effects upon the most diverse constitutions. It is, however, clear and agreeable to the taste, though very hard. Its examination resulted as follows: On evaporation it leaves a residue corresponding to 26.50 grains per gallon, which, on a light ignition, loses 1.76 grains of water and some organic matter. Of the remainder, the largest part is insoluble in water. These portions are composed as follows:

SOLUBLE PART.	Grains per Gal.	Per Ct.
Chloride of Sodium (Common Salt).....	5.79	22.02
Sulphate of Lime (Gypsum).....	.85	3.23
Chloride of Calcium.....	.13	.48
Chloride of Magnesium (Bittern).....	.33	.89
Organic Matter and Loss.....	1.76	6.70
Total Soluble.....	8.76	33.32
INSOLUBLE PART.		
Carbonate of Lime.....	12.73	48.42
Carbonate of Magnesia.....	2.76	10.40
Sulphate of Lime (Gypsum).....	.17	.65
Silica.....	1.97	7.51
Total Insoluble.....	17.53	66.63

It will be noted that two-thirds of the entire mineral ingredients are insoluble in pure water, and remain dissolved only by the agency of the carbonic acid gas with which the water is charged. Boiling alone should, therefore, so far diminish the mineral contents as to render the remainder too small to be of any consequence. But there is another and easier mode of correcting the water for all ordinary purposes. When it is mixed with one-fifth of its bulk of clear lime water, it becomes milky and within an hour or two a white powder settles to the bottom of the tank, leaving the water clear and thereafter unobjectionable to the most delicate stomach; as also adapted to washing with soap. The lime water is easily kept on hand at all times in a barrel containing a handful of quicklime and filled with water.

Some other waters of the neighborhood were then cursorily examined as to their total con-

tents and proportions of soluble and "insoluble" (or easily precipitable) mineral matter. The results are given in the following table:

WATERS FROM MISSION SAN JOSE.

WATER FROM	Total Residue. Grains per Gallon.	Insoluble Residue. Grains per Gallon.	Soluble Residue. Grains per Gallon.
1—Spring creek, Salazar's land.....	26.5	17.6	8.9
2—Bored well, Montalegre's land.....	25.6	12.8	12.8
3—Mission creek, Gallegos' land.....	19.3	13.2	7.1
4—Mission spring, Gallegos' land.....	24.6	13.7	10.9

It will be noted that all these waters are quite "hard," that is, contain an amount of earthy mineral salts sufficient to require correction before they will readily take soap. The water of Mission creek is the softest, and contains the smallest amount of soluble salts; what there is, is almost wholly common salt, and therefore quite unobjectionable. The water of the Mission spring, No. 4, is harder and contains in addition to common salt, some gypsum and Glauber's salt. The water of Montalegre's well is quite similar to that of the spring, No. 4, though containing a larger proportion of soluble salts. All can be freed from the excess of lime they contain, by the addition of a certain proportion of lime water, which in their case is needed only to the extent of one-fifteenth, in order to produce the maximum precipitation of the earthy matters—it is well known that calcareous waters, are on the whole considered as conducive to good health, partly for the reason that they supply liberally one of the important ingredients of bones, and also tend to correct a too acid condition of the gastric juice. Permanent residents therefore rarely complain of such waters. But it is none the less important to newcomers to possess the means of correcting, as far as necessary, the unpleasant effects liable to be experienced at first.

From the uniformity of the geological formations for considerable distances in every direction, it is probable that the above analyses are more or less representative of a large proportion of the waters of the Santa Clara valley and adjacent mountains, in so far as all are probably of the calcareous class. The heavy deposits of tufa in the Santa Cruz range speak of the lime in its waters; and the same is true in a less degree in Livermore valley, on the west side at least. So long as the presence of alkaline and magnesian salts does not complicate matters, few probably will complain of this peculiarity.

E. W. HILGARD.

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